LOCKHEED MARTIN

Memorandum

2L-04-013

June 22, 2004

To: Jim L. Thompson (S22)/Systems Engineering and Integration

From: Elton G. Witt (S22)/ Project Manager, HRF Flight Racks/Payload Systems Section

Subject: Human Research Facility Rack 2 Review of Design

Purpose

The information detailed in this memorandum is specific to the Human Research Facility (HRF) Flight Rack 2 Empty Rack Assembly (Part number: SEG46118352-301). The purpose of this memorandum is to provide a configuration overview, outline the certification/verification processes and responsibilities, and detail the post shipment configuration management process for the above-mentioned assembly.

Background

Certification/verification processes for the HRF Integrated Rack, its sub-assemblies, and components were detailed in the December 7, 2001 HRF Rack Systems Technical Interchange Meeting (TIM). Official minutes from this meeting are documented in Memorandum 2T-01-016.

HRF Rack 2 Configuration Overview

During build-up of the HRF Integrated Rack 2, four primary configurations were established: the EXPRESS provided Flight Rack (683-46051-4), the HRF Flight Rack 2 Empty Rack Assembly (SEG46118352-301) also called the "Outfitted Rack", the HRF Flight Rack 2 Launch Configuration Assembly (SEG46118352-301), and the HRF Flight Rack 2A On-Orbit Assembly (SAG46118354). The following paragraphs provide an overview of the processes for fabrication/modification and certification/verification of each configuration with the specific certification approach concerning the HRF Flight Rack 2 Empty Rack Assembly (SEG46118352-301). For the sake of clarity Figure 1 provides an overview of the build-up processes.

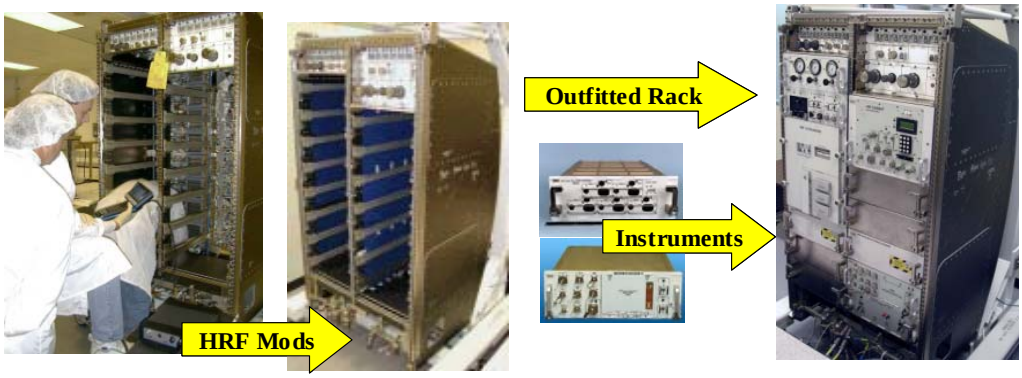

Figure 1. Integration Process Flow

The fourth configuration will be established after Rack 2 is transported on-orbit. This configuration will be the first operational configuration of Rack 2 and is designated "FR2A". Instruments between rack 1, already on-orbit, and Rack 2 (in the launch configuration) will be exchanged and rearranged. A drawing controls this configuration: HRF Flight Rack 2A On-Orbit Configuration Assembly, SAG46118354. It should be noted that no on-orbit operations are carried out in the Launch Configuration, designated as "FR2".

Boeing EXpedite the Processing of Experiments to Space Station (EXPRESS) in conjunction with National Aeronautics and Space Administration (NASA)/Marshall Space Flight Center (MSFC) is responsible for the design, manufacture, verification, and delivery of the Flight Rack to the Engineering Directorate/EA5 division of NASA/Johnson Space Center (JSC). The HRF Rack 2 specifications for design, development, performance, and verification requirements are contained in the Prime Item Development Specification for the Human Research Facility Rack, S683-34510C. A Functional Configuration Audit (FCA) and a Physical Configuration Audit (PCA), held during the week of July 31, 2002, ensured that the requirements listed in S683-34510C were met. The outstanding issues and open items from the FCA/PCA were resolved and a final copy of the 683-46051-4 Acceptance Data Package (ADP) is included in this data package. It should be noted that EXPRESS considers the HRF Empty Rack (Rack 2), 683-46051-4, a 'recurring unit' of HRF Empty Rack 1, 683-46051-2. Some requirements were closed 'by similarity' to HRF Empty Rack 1.

"Empty Rack"/HRF Rack 2: 683-46051-4

- Requirements Documentation
  Prime Item Development Specification for the Human Research Facility Rack, S683-34510C

- Verification/Certification Process
  Responsibility of Boeing EXPRESS/MSFC (FCA/PCA with ADP)

- Open Items
  Responsibility of Boeing EXPRESS/MSFC (No known open items)

Upon receipt from MSFC, the EA5 division of NASA/JSC in conjunction with Lockheed Martin Space Operations outfitted the Empty Rack in preparation for instrument integration. The modifications made to the Flight Rack 2 assembly are detailed in the SED46118352-301 drawing package and were driven by three HRF CCB Change Requests (CR). Each of the three CRs were presented and approved by the HRF Configuration Control Board (CCB).

1. CR HLP-HDCI-0003 specified the Standard Interface Rack (SIR)1/SIR9 bracket modification and labeling.
2. CR HLP1-FHD-0001 identified the changes required for installation of acoustic abatement materials.
3. CR IJULF-1-HRF-0001 identified changes required for installation of the instrument mounting brackets.

The EA5 Division of NASA/JSC completed the outfitting of HRF Rack 2 in accordance with the current JSC ISO 9000 work instructions, and with Safety, Reliability and Quality Assurance (SR&QA) oversight provided by Occupational Safety and Institutional Assurance/NT. Open items associated with the Outfitted Rack configuration are detailed below.

"Outfitted Rack"/Flight Rack 2 Empty Rack Assembly, SEG46118352-301

- Modifications to 683-46051-4
  SIR1/SIR9 Bracket Modification (TPS # 7H0120558)
  Addition of Acoustic Abatement Material (TPS # 7H0120558)
  Instrument Bracket Assemblies (TPS # 7H0220657)
  Labeling (TPS # 7H0120558)

- Certification Process
  Certification Package (GCAR/ADP) addressing additions/deviations to 683-46051-4 Certification Package is the responsibility of EB Division of NASA/JSC

- Verification Process
  Verification is addressed at the integrated rack level only, on the FR2A configuration for operations, and the FR2 configuration for launch

- Open Items (to Date)
  None.

After outfitting was complete, Flight Rack 2 Empty Rack Assembly was populated with sub-rack instruments to establish Rack 2 in either the launch configuration "FR2", part number SEG46118353-301, or the on-orbit configuration "FR2A", controlled by drawing SAG46118354. It should be noted that the Outfitted Rack is de-integrated for shipping.

Specifications for system interface verification are contained in the Payload Verification Plan for the HRF, SSP57452. The EA5 division of NASA/JSC implemented the portions of this document that were specific to test, inspection, and analysis. The data obtained from these activities was provided to the Space and Life Sciences Directorate/SA for verification closure. The Payloads/OZ division of NASA/JSC will produce a program record that the requirements of SSP57452 are met. Open issues specific to the SSP57452 verification requirements are detailed below. Exceptions to the requirements are documented in the HRF Rack 2 ICD, SSP 57252.

HRF Flight Rack 2 Launch Configuration Assembly: SEG46118353-301
HRF Flight Rack 2A On-Orbit Configuration Assembly: SAG46118354

- Requirements Documentation
  HRF Rack 2 Unique Payload Verification Plan, SSP57452

- Verification/Certification Process
  System verification responsibility of SA/EB and OZ divisions of NASA/JSC
  No unique systems certification

- Open Items (to Date):
  Responsibility of SA/EB and OZ divisions of NASA/JSC

Post Shipment Configuration Management

After completion of the JSC verification and certification testing, the Integrated Rack was de-integrated for component shipment to Kennedy Space Center (KSC). The components were re-integrated, functionally tested, and/or configured in the offline facilities at KSC in accordance with existing JSC ISO 9000 work instructions, and with SR&QA oversight provided by the NT division of JSC. Upon completion of offline testing the Integrated Rack was turned over to the Kennedy Space Center via an Integration Data Package (IDP) for ULF-1 Mission Testing. The Integrated Rack IDP details the hardware and software configurations, listed shortages, and identified any deferred/open work. All remaining work affecting the (HRF) Flight Rack 2 Empty Rack Assembly SEG46118352-301 configuration was accomplished via KSC Task Performance Sheets (TPS) in accordance with KSC ISO 9000 and SR&QA work instructions. Copies of the completed TPSs have been included in the HRF Flight Rack 2 Empty Rack Assembly SEG46118352-301 Acceptance Data Package (ADP). The Integrated Rack 2 was installed in the carrier for launch in the Space Shuttle.

However, due to the Columbia disaster, the launch was delayed and the rack was removed from the carrier and moved to the off-line laboratory. During a subsequent instrument test, a failure of the EXPRESS Memory Unit (P/N 683-46310-001, S/N 1009) was observed and the unit was replaced with S/N 1002. Also during this time, the Solid State Power Control Module (P/N 9070147-1, S/N 000006) was modified in-place by EXPRESS per Modification Kit 9070802-1 Rev. C (Reference: SCAN No. PG3-020 and SSCN 008087). The Acceptance Data Package for this

Modification Kit is available for review upon request. The modification provides insulation to a printed wiring board card edge and ejector inside the SSPCM to prevent contact with the metal case during launch vibration. There are no other changes to the outfitted rack assembly at this time. However, another change to the SSPCM is anticipated (SSCN 008722), but has not been coordinated. Plus it is highly likely that the ISS Thermal Control System fluid will be reformulated requiring a fluid replacement prior to launch. An updated memorandum will be generated when this, or any other change, occurs.

If any questions arise or require additional documentation please feel free to contact me at 281-218-3105.

Elton G. Witt

cc:
LM/S22/D. Barb
HRF Rack 2 GCAR Book
HRF Rack 2 Hardware ADP Book